Claims

[c1] What is claimed is:

1. A method of detecting extended range motion and counting moving objects using an acoustics microphone array, the method comprising:
using an optimized beamforming process to create a plurality of acoustic beams comprised of a plurality of focused listening directions;
detecting the presence of one or more of a plurality of objects moving through the acoustic beams;
verifying that the objects are valid objects to be counted; and
verifying a plurality of valid directional information of the objects within the acoustic beams.

[c2] 2. The method of claim 1, further comprising computing a power spectrum for each of a plurality of acoustic beams.

[c3] 3. The method of claim 1, further comprising selecting a single loudest spectral component from a plurality of spectral components using a first beamforming process.

[c4] 4. The method of claim 3, further comprising computing a bearing to each of the spectral components using the first beamforming process.

[c5] 5. The method of claim 4, further comprising generating a steering vector for each of a plurality of principal azimuthal directions.

[c6] 6. The method of claim 5, further comprising generating the steering vector for a trip line direction.

[c7] 7. The method of claim 6, further comprising computing a correlation matrix with regularization at each of a plurality of frequencies using the spectral components across all the plurality of frequencies5, step 620.

[c8] 8. The method of claim 7, further comprising computing a plurality of optimum weight 0vectors Block 425, step 625.

[c9] 9. The method of claim 8, further comprising steering the beams and computing a beamformer output power in the principal direction and the trip line direction Block 425, step 630.

[c10] 10. The method of claim 9, further comprising computing a value of background noise for the plurality of frequencies Block 425, step 635.

[c11] 11. The method of claim 10, further comprising computing a signal to noise ration for each of the spectral components Block 430.

[c12] 12. The method of claim 11, further comprising designating a look direction beam by retaining the spectral components in each of the beams that are greater than a threshold Block 445.

[c13] 13. The method of claim 12, further comprising assigning a bearing to a plurality of retained spectral components Block 450.

[c14] 14. The method of claim 13, further comprising retaining a plurality of components that fall within a bearing tolerance of each of a plurality of beams in the look direction Block 450.

[c15] 15. The method of claim 14, further comprising counting a total number of the components in each of the look directions Block 455.

[c16] 16. The method of claim 15, further comprising incrementing a trip line event counter if the trip line event counter is not previously set and an adequate time delay has occurred since the last trip line event.

[c17] 17. A system for detecting extended range motion and counting moving objects using an acoustics microphone array, the system comprising:
means for using an optimized beamforming process to create a plurality of acoustic beams comprised of a plurality of focused listening directions;
means for detecting the presence of one or more of a plurality of objects moving through the acoustic beams;
means for verifying that the objects are valid objects to be counted; and
means for verifying a plurality of valid directional information of the objects within the acoustic beams Block 415.

[c18] 18. The system of claim 17, further comprising means for computing a power spectrum for each of a plurality of acoustic beams.

[c19] 19. The system of claim 17, further comprising means for selecting a single loudest spectral component from a plurality of spectral components using a first beamforming process Block 420, step 535.

[c20] 20. The system of claim 19, further comprising computing a bearing to each of the spectral components using the first beamforming process Block 425, step 610.

[c21] 21. A system having instruction codes for detecting extended range motion and counting moving objects using an acoustics microphone array, the system comprising:

a first set of instruction codes for using an optimized beamforming process to create a plurality of acoustic beams comprised of a plurality of focused listening directions;

a second set of instruction codes for detecting the presence of one or more of a plurality of objects moving through the acoustic beams;

a third set of instruction codes for verifying that the objects are valid objects to be counted; and

a fourth set of instruction codes for verifying a plurality of valid directional information of the objects within the acoustic beams Block 415.

[c22] 22. The system of claim 21, further comprising a fifth set of instruction codes for computing a power spectrum for each of a plurality of acoustic beams.

[c23] 23. The system of claim 21, further comprising a sixth set of instruction codes for selecting a single loudest spectral component from a plurality of spectral components using a first beamforming process Block 420, step 535.

[c24] 24. The system of claim 23, further comprising a seventh set of instruction codes for computing a bearing to each of the spectral components using the first beamforming process Block 425, step 610.

[c25] 25. The system of claim 24, further comprising an eight set of instruction codes for generating a steering vector for each of a plurality of principal azimuthal directions Block 425, step 610.